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#AgTechTakeback

As the role of technology increases in farming and food, and corporate powers use this to extend their power, we need to strive for technological developments that are appropriate for farmers, for eaters and for the planet. Join the #AgTechTakeback debate.

Content

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There is indeed a scary story of corporate takeover, disempowered farmers, and duped consumers. But there are also empowering and inspiring examples of farmers embracing the best, most appropriate, of technologies to grow agroecologically.

Farm Technology Can Work For All

Karen Hansen-Kuhn in the U.S.A. and Dr. Oliver Moore in Ireland

Agriculture has always embraced technology. Perhaps the plough was the first, though even before then we humans harnessed nature with tools to feed ourselves.

War sped up this process of using technology for food production – spam, pesticides, mineral fertilizer, the tractor and even factory farmed chicken all came from 19th and 20th Century conflicts.

Today, digitization– the increasingly integrated use of aggregated data services and tools - is seen as part of a fourth industrial revolution which Coventry based researchers Pimbert and Anderson suggest involves "a fusion of technologies that blurs the lines between physical, digital and biological domains".

We've seen the emergence of drones, robots and AI, remote sensors and big data, penetrating ever deeper into all aspects of farming and food.

There is indeed a scary story of corporate takeover, disempowered farmers, and duped consumers. But there are also empowering and inspiring examples of farmers embracing the best, most appropriate, of technologies to grow agroecologically.

This deepening of technology into the agricultural sphere has been part of the inspiration in running this series, while the creative responses by farmers to this dynamic is part of what gives us the takeback in AgTechTakeback.

Below we introduce the authors (in bold) in this report while also adding some extra considerations and analysis. All of the main articles cited below and in this report have also appeared on our ARC2020 website.

Digitization and path dependency

Digitization is just part of a process of companies increasing control upstream and downstream in the whole food chain, sometimes called vertical integration. As **Jason Davidson** of Friends of the Earth USA spotlighted, the same four mega-corporations that control seeds and pesticides (Bayer-Monsanto, DowDuPont, Syngenta-ChemChina and BASF) control more and more of digital agriculture, too.

Farmers buy into knowledge platforms such as Bayer-Monsanto's Climate FieldView , DowDupont's Granular, Encirca and AcreValue, Syngenta's AgriEdge Excelsior and BASF's Xarvio and Maglis.

This level, of concentration is anti-competitive, while farmer's rights – to their own data outside of the platform, for example - are strained.

As **Laura Skove** points out, when advice becomes both very precise and tailored to the provided inputs and processes, other options, or other approaches, fade out of view. When a farmer takes on debt to purchase a high-tech tractor, for example, all too often the farmer will enter into a path of debt dependency that emerges define the limits of the possible:

"Technology comes at a cost, and it is worth considering the impact of *farm debt* on farmers' ability to innovate and to transition towards agroecological practices. Agro-industrial technologies, when adopted at the cost of medium- and long-term debt, create path dependence and lock farmers in to high-carbon practices."

Meanwhile, who owns big data? When it comes to the mega-Corporation's platforms, a concern is that farmers can't access their information if they leave the platform. Not having access to information about their own fields and soil moisture suddenly puts them at a competitive disadvantage. And the spectre of aggregated data being used by corporations on commodities markets is on the horizon.

Instead, as Greek agronomist **Vassilis Gkisakis** puts it, what generally emerges with digital agriculture is "a partial increase in the efficiency of inputs and resource use and some decrease of production costs, which are however accompanied by the high costs of farm management's mechanization. Often these tools developed ignore main ecological processes, under whose principles the agricultural ecosystems function."

These are inappropriate for smaller producers and can lead to partial solutions divorced from holistic approaches to farming with(in) nature.

Agroecology

Knowledge-intensive, ecologically-sensitive and farmer-empowering approaches like agroecology are different. Agroecology learns from nature in general and biology in particular. In the case of weeds – plants in the wrong place – a many little hammers approach is emphasized. As the Pesticide Action Network Europe "Integrated Weed Management" publication emphasizes, there are indeed a multitude of techniques organic farmers, agroecologists and others are already employing:

“By integrating physical or mechanical, biological and ecological agricultural practices with the broad knowledge acquired on the biological and ecological characteristics of crop plants and weeds, farmers can successfully manage weeds without herbicides, while maintaining high yields, avoiding building resistance in weed species, protecting soil health and biodiversity and minimising erosion.”

Indeed bringing livestock and crops together makes sense from a whole system perspective –composted animal manures bring in excellent fertility, there are soil and climate change benefits to mixed species swards, clover reduces the need for damaging nitrogen fertilizer, while there are many more regenerative practices bring trialled by pioneers.

The block, as IPES Food’s Olivier de Schutter points out, “is not a lack of evidence holding back the agroecological alternative. It is the mismatch between its huge potential to improve outcomes across food systems, and its much smaller potential to generate profits for agribusiness firms.”

Simply put, agroecology uses knowledge and nature, not high-tech debt. And it could even work on a large scale in places as modernized as Europe.

Technological sovereignty

When it comes to machinery, the time honored right-to-repair machinery by the farmer is increasingly restricted. Many farmers revel in fixing their own equipment and machinery – it’s a cost-effective, empowering and savvy way to keep the farm working. This is not always possible now, with for example proprietary technology in tractors.

Indeed, it is these very sorts of restrictions that have led to what is sometimes called the technological sovereignty, or, more simply, the farm hack movement. This is a global movement of farmers rejecting locked-away technology, sharing and tweaking their plans for building and modifying appropriate machinery for their ecological farming practices. Mixed agroecological farming requires new tools for seeding and weeding, for washing and winnowing. Farm hackers are making them – collectively.

French farm hackers L’Alterier Paysan has five trucks equipped with the machinery and materials needed to run 80 or so courses and workshops a year. Self-built farmer-led machinery is their specialty. And they throw great make-and-do parties.

Julien Reynier of the French organization explains: “We identify and document inventions and adaptations of tools, created by farmers who have not waited for ready-made solutions from experts or the industry, but have invented or tweaked their own machinery. We seek to

Karen Hansen-Kuhn has been working on trade and economic justice since the beginning of the NAFTA debate. She has published articles on U.S. trade and agriculture policies, the impacts of U.S. biofuels policies on food security, and women and food crises. She started to learn about the challenges facing farmers as a Peace Corps Volunteer in Paraguay, where she worked with a rural cooperative. She was the international coordinator of the Alliance for Responsible Trade (ART), a U.S. multisectoral coalition promoting just and sustainable trade, until 2005. After that, she was policy director at the U.S. office of ActionAid, an international development organization. She holds a B.S. in International Business from the University of Colorado and a master's degree in International Development from The American University.

promote these farmer-driven innovations. Our internet forum, which acts like a collective sketch-book, is designed to make these contributions visible and accessible."

He adds: "We believe we can make technical choices and invent sophisticated low-tech solutions. We don't want to be overwhelmed by trendy, plug-and-play and miraculous high-tech tools that will only make us more dependent, will be more intrusive and less controllable."

Retro-innovation

Stuart Meikle's idea of retro-innovation chimes well with this spirit. Meikle goes back to the future and uncovers a treasure trove of solutions as proffered in the 1950s, from Friend Sykes in particular, with his knowledge then of mycorrhiza, the harm done to these by artificial fertilizers, and the benefits of mixed swards for soil structure.

There is much to learn from the forgotten books of the pre-mineral fertilizer era, when 'humus farming' was that day's version of biological or regenerative farming.

Farmer-led innovation, soil-aware, regenerative innovation - is where this slippery term must be housed if it's to benefit people and planet, and not just corporate forces: indeed concerns have been expressed that, when it comes to Research and Development in agri-food, innovation is being used simply a cover phrase for business-as-usual.

Big open and ok

Big isn't always bad though. Even at a higher tech level, citizen science initiatives can use aggregated data for positive purposes, often incorporating smartphones. Fair chain is one example of the much hyped blockchain where value and roasting infrastructure is shifted back to the coffee producers. And, as **Gabriel Ash** shows us, it's worth noting the overlap between the FOSS - free, open source software – movement and the farm hack movement and, more specifically the US Open Source Seed Initiative, with its 400 pledged seed varieties, or the German Open Source Seeds movement, which is copyleft and includes derivatives. In each of these cases, it is farmers and local communities -- not agribusinesses -- who control the rights to and the use of that data.

In addition to who controls the data, as food rights campaigners FIAN International point out, it's also important to be aware of the power dynamics behind how food becomes immaterial - how elements are extracted from their natural and human, peasant farming

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core: “separated from the microorganisms, plants and animals that they stem from, and indeed they are further isolated away from the persons who provided all related knowledge.”

Key learnings

Some learnings that have emerged from the series:

- The speed of corporate data and power capture through the convenience of mega platforms is dizzying.
- This and other innovations can lock farmers into a business-as-usual path they cannot escape from.
- Some farmers are responding to this dynamic by developing technological sovereignty and working together.
- CAP, from the emphasis on digitization and smart farming in the Commission’s CAP consultation document, to the innovation principle as brought into Horizon Europe, risks being unbalanced towards high tech, high expense, path dependency. The balance needs to swing more towards EIP and other more agroecologically focused areas.
- We have much to learn from elsewhere, from the past, from new agricultural movements. This includes the open source movement on line, the pre-mineral fertilizer era, and (re)new(ed) regenerative and biological approaches to farming. These holistic agroecology approaches can bring the more appropriate of technologies forward, while being nature-embedded and farmer driven.

This new frontier of food, where digitization and technology pervade, is still a contested space. Let’s push for technologies, from open plans to open pollinated seeds, from accessing your own data to modifying your own machinery, that work for everyone.

This article can be found at the ARC2020 website.

The idea of permanent, “ridged” beds is to form perennial growing beds so the tractor wheels always run in the same place. Tools are needed to form these ridged beds, which allow crops to have superior moisture retention and drainage, and to warm up better in the sun.

L’Atelier Paysan on Self-Build Communities in Farming

The P2P Foundation’s Michel Bauwens interviews Julien Reynier and Fabrice Clerc from L’Atelier Paysan

L’Atelier Paysan is a French cooperative that works with farmers to design machines and buildings adapted to the specific practices of small farm agroecology. In addition to distributing free plans on its website, L’Atelier Paysan organizes winter self-help training sessions, during which farmers train in metalworking and build tools which they can then use on their own farms. L’Atelier Paysan works to develop the technological sovereignty of farmers by helping them to become more autonomous through learning and regain knowledge and skills.

In market gardening, crops are grown on beds formed from long strips of land. Generally, little or no attention is paid to ground compaction by tractor wheels. In subsequent years, farmers will then try to grow on these tracks. The idea of permanent, “ridged” beds is to form perennial growing beds so the tractor wheels always run in the same place. Tools are needed to form these ridged beds, which allow crops to have superior moisture retention and drainage, and to warm up better in the sun.

Michel Bauwens: What was the origin of L’Atelier Paysan project?

Julien and Fabrice: The project was born in 2009 after a meeting between Joseph Templier, an organic market gardener from GAEC “Les Jardins du Temple” in Isère (south-eastern France, near the Alps), and Fabrice Clerc, then a technician with ADABio, the local organic agriculture development association. ADABio was created in 1984 to help improve practices, find resources, and share knowledge, among other things.

Joseph and his colleagues used tools on the farm that are very relevant to the soil, especially adapted to an innovative cultural technique called “permanent beds”. Many young farmers came to train in the techniques, the system and the organization of the “Jardins du Temple” and then to practice them on their own farms and projects. At the same time, Fabrice went to many farms in the Rhone Alps to collect and disseminate knowledge and agrarian know-how. Fabrice and Joseph’s idea was to widely publicise the innovative tools used on this farm, which were crafted and assembled from recovered materials and refurbished old tools. Some standardization was necessary first, in order to be able to

publish plans for building the tools from parts and accessories that can be found at any hardware store.

Your approach seems very pragmatic. Yet when I read through your website, it is also a very thoughtful approach (philosophical and political). How did you move from one approach to another?

We have just put into words what is happening. A number of farmers in the Alps independently designed and built their own machines, adapted to their own needs. We have gathered and compiled all this into a guide. In the process of constructing this guide, it seemed useful to formalise our approach: first, to take an inventory of innovations on the ground, then to answer the question "what is the meaning of all this?" Why all these bottom-up innovations, which were traditionally outsourced to the equipment manufacturing industry. So, why was the farming world excluded from the design process? Whereas the farmer and the artisan of the village once built the machines needed, now farmers have disappeared from the chain of innovation.

It is not only in the agricultural sector that this has happened: it's possible to build bridges with changes in other areas such as shared self-build community workshops, and to think about Do It Yourself from the viewpoint of human/social (re)construction. For example, in Grenoble, there are about ten woodworking workshops with available machines and tools, and self-renovation housing initiatives. They are important factors for emancipation, inclusion and social reintegration. For the last 6 or 7 years, we have been thinking a lot about these issues. We don't want to just make machines. It is a total experience that consists of thinking about daily life and of the political approach it requires.

Current political debate reflects a very strong social demand on the ground. The guide to self-construction is the first book we published in 2012. This is the sum of the first field census of sixteen machines adapted to organic market gardening. These machines, which are low tech (in construction and design) call for a lot of craft know-how. They do not suffer in comparison with high-tech machines. Our machines are three to four times cheaper for an efficiency equal or superior to those of the trade. Why is this search for autonomy not more valued? This is a question of the technological sovereignty of farmers. It is something that is coming back into fashion, taken up by a militant farming community.

The word "farmer" was, until the 1980s, a word used to denigrate. Today, on the contrary, it means someone who is not only a cultivator of agricultural produce but part of a *terroir*, connected to an ecosystem and a social life. The word "farmer" relates to the invention of a

specialized, segmented profession. Today they are even called “producer”, “operator”, or “Chief Operating Officer”. The logic of industrialists and economists invades agriculture.

Photos in this article come from another really interesting essay about the event les Rencontres de l’Atelier Paysan. Words (at the link) and photos (here and at the link) by Samuel Oslund of l’Atelier Paysan.

What are the current project developments?

The approach is open to the whole field of small and organic farming on a human scale. It started around organic market gardening, but now it is open to all sectors: arboriculture, breeding, viticulture… For example, we can include the re-design of livestock buildings and storage. For market gardeners who want to add some poultry farming to their production, we are also working on the issue of mobile buildings.

Depending on the demands of the farmers’ groups on the ground, our resource platform will respond to co-design the tools required for the specific practices of small and organic farmers. We want these tools to be used by conventional farmers to help them adopt a more autonomous and economical approach. It is becoming increasingly credible because it is intended to be a resource available to all farmers. Most of our users are already going through this process, but the technical principles developed, aim to ensure that conventional farmers are no longer frightened by the demanding, know-how-based, techniques of small farm agroecology.

The project started in 2009 at ADABio, a local association of organic producers, but very quickly grew to such a large scale that in 2011 a transitional association was created and then converted into a cooperative in 2014: L’Atelier Paysan. In this human adventure, meetings played a very important part. At each meeting, we took sideways steps, then small jumps and then big jumps. Today we are 11 permanent staff, quite a lot of seasonal staff as well as those who volunteer as a civic service. Everyone comes as who they are and our approach is closely linked to what each person brings. We are very attentive to the requests that come to us, and we have more and more!

What is your business model?

We operate 65% through self-financing and 35% from public funding. In our view, these are normal contributions to our effort to produce and disseminate common goods. We believe that we are in the public interest and that communities need to be involved. Unfortunately,

with the reactionary right-wing coming to power in many places, this sort of support has been drastically reduced.

However, we are relatively more secure than other structures, sometimes subsidized at 80%. The 65% self-financing comes from our self-build training activity. In France there are joint vocational training funds that can cover the cost of training. We also profit from a margin on group orders for internships.

We will raise funds more and more from the public: if we want to change the agriculture / food model, the whole of society is involved. That's why we have set up a partnership with a Citoyens Solidaire endowment fund to collect donations and the associated tax*. It is a mechanism that allows people to choose where their taxes are going. We want to make citizens aware of our work so that they can contribute to the economic independence of L'Atelier Paysan.

What is your relationship with other farmer or social movements?

L'Atelier Paysan is positioned as one of the actors in the alternative food project, an additional tool in the social and solidarity-based agricultural economy. As actors of this arena, we naturally wanted to associate ourselves with those that represent the agricultural environment, to connect, so that they might disseminate our information, our technical material and to bring together our different users. Moreover, the question of agricultural machinery was very seldom dealt with by the existing organisations.

Also, we have had an awareness-raising activity for a year now, through the InPACTassociation, which brings together about ten associations at the national level. We have been the standard-bearers for the technological sovereignty of farmers in this context, in particular to document and expose, on the one hand, the over-sizing of farming equipment production tool and, on the other hand, the publicly funded introduction of robotics and digital technology supported by the techno-scientific community.

At the international level, we are in the Via Campesina network. We participated in the 2nd Nyéléni forum on food sovereignty (in October 2016 in Romania) where we talked about agricultural equipment, saying that there can be no food independence without farmers' technological sovereignty.

At the forum we met with Spaniards, Romanians, Austrians, Czechs and Hungarians, who were very interested in questions around farming equipment. We staged an exhibition of drawings and fact sheets that really appealed to people. It was not especially a field of

exploration for these activists, and there, something happened. No one in Europe has yet set up a platform such as L'Atelier Paysan, which provides ways to document and disseminate knowledge (data sheets, self-construction training …).

We went to Quebec in January 2014 to organize the first self-build training in North America, with the CAPÉ (Coopérative d'Agriculteurs de Proximlité Écologique) and l'EPSH (École professionnelle de Saint-Hyacinthe), around the vibroplanche (for cultivating permanent "ridged" beds). And now, they independently create self-build courses from the shared tools on our website.

In the United States, we are connected with Farm Hack, incubated and launched by Greenhorns, which itself came from a young-farmer's coalition, the NYFC (National Young Farmers Coalition). They share tips on adapting machinery via hackathons and open-hacking camps. Though they have not yet organized any training.

We also have discussions with the Land Workers Alliance (a member of Via Campesina) in England. Two years ago, they organized the first Farmhack event which we attended to present our work.

Here, a farmer can come for training and can build their own tools: it doesn't cost much thanks to our famous training funds and group-buying of materials and accessories. Working with metal, tool use (a kind of after-sales service), sharing (using the machine and adapting it to their context in the form of versioning); this is the whole methodology that one wants to share. There is a very specific context in France, which means that a structure like ours can still rely on a large amount of public aid and shared professional funds to pay for the internships (this is not the case in the USA, for example, which has to rely on private funds).

In general, our approach is total, that is what is exciting in this adventure. We are giving ourselves the means to advance this process, between ourselves and with other actors. From a practical point of view, to reach one person is good, but to reach many takes us much further. We also consider political and economic issues, and what are the factors for acceleration and efficiency. The question of agricultural machinery is a question of political and scientific thought. On the whole, on a whole bunch of questions, there is no science-based production. On April 5th we are organizing a seminar on technological sovereignty: we have struggled to find people who have admitted incompetence. These are questions they have never faced.

What do you think of the "Commons" as a political concept?

We would like to be further advanced on this issue of the Commons. We assume that the issue of food, like drinking water, the air we breathe and biodiversity, are essential to protect. In turn, the means to achieve it (know-how, agricultural land, communal areas, techniques…) must by definition be common, since this is the survival of our species. All the know-how and the knowledge of farmers did not come ex nihilo [from nothing. Ed]: they come from sharing, putting into a common pot, shared innovation and openness. We see as a scandal any attempt to expropriate technological solutions so that they can be part of another feed-source for personal profit. This is an issue that we are exploring and trying to pay attention to.

We are alert to the legal regimes related to this issue of the Commons, to open licenses and to what could best reflect this willingness to share knowledge through which we enrich our community of users. If we use Creative Commons, we are always looking for the right license that best expresses this willingness to share.

The starting material of our work are the tools developed by Joseph: he participated very much in the emergence of these communities. But he didn't only tinker with machines, he also thought of them with regard to a working group of farmers who wanted to adopt the innovative cultural techniques of permanent beds. His machines are designed in a collective. It is therefore the result of a whole lot of visits and picking up of knowledge and know-how from his peers. He had the talent and the energy to imagine and manufacture these machines. It is his way of contributing, like other activists.

How do you see social change? The political atmosphere is not very positive for the change we want. Do you imagine that you work in a "hostile environment"? Is there a political side to your work?

There is the question of public education. The first step of the document on the technological sovereignty of farmers will be to amalgamate the ideas of the users, the political partners, etc. Some participants in our training events do not take long to take the ideas and techniques and disseminate them.

We are also starting to have quite a lot of feedback from researchers / thinkers, who congratulate us for imagining this new way of thinking. This is our goal because we are not going to be able to produce everything: scientific studies, political thinking … What

partnerships can be set up to make common the commonalities of these subjects? Additional advocates can be found at meetings. We do not have a strategy. There is nothing stronger than a groundswell to spread our way of doing things. The tidal wave will be less important, there will be no media buzz, no pretty teaser with a background of country music, but this is much more powerful. When people have experienced their ability for self-determination, there is a kind of arriving without the possibility of backtracking.

Are there projects similar to yours but which you criticize and if so, why?

We are quite distinct from the sort of ideas promoted by the likes of Open Source Ecology in the US with a beautiful trailer, to us that does not seem grounded in reality. None of the machines actually work. It is a process of innovation that comes from not involving real users. They are engineers who imagine things a bit on their own.

We are also distancing ourselves from Fablabs, which seem to be an incubator for start-ups rather than for public education. For us, a Fablab must be a place of public education and not of low-cost technological experimentation for the industry.

We are in Grenoble, the cradle of nanotechnology. Here, a Fablab is funded by industry and advanced technology. So there is Fablab after Fablab (woodworking, pedal-powered machines…), and they are generally talking about something other than the quality of what is produced. It takes funding to run a Fablab. In 2013, those who won the call for projects from the Ministry of the Digital Economy are not those who provide public education. How do we finance a general interest?

More broadly, if by Fablab we mean laboratories of open innovation and shared human resources, there are tens of thousands in France. There are ecocentres, Third-Places, associations related to self-build, others that repair bicycles, social innovation, human and economic. They are not necessarily in the high-tech field and are less publicized, but they are working on the necessary questions.

Where do you see yourself in 10 years? How do you think the world will be in which you will evolve? Do you project yourself into the "global arena" and if yes / no, why and how?

The observation is that today, in January, we do not know much about where we will be at

Michel Bauwens is the founder and president of the P2P Foundation and works in collaboration with a global group of researchers in the exploration of peer production, governance, and property.

the end of December. This has been true since the beginning of the adventure. We are in an exploratory phase, and it is very difficult to know where we will be in 3 years. After 5 years we have already exceeded our dreams of 3 or 4 years ago! Our collective dynamics explode, economically we will have to find more avenues because humanly we will not be able to go much further. We refuse work every day! One of the interesting tracks in a time-scale of 3 or 4 years is to set up our own training centre on a farm with a workshop training centre suited to our needs, a logistics platform, a classroom, offices, garages, and accommodation. Why a farm? To have our feet on the ground, a real support for our experimentation and a working tool to match our needs. Today we operate within our means, but we have ways to improve our work.

In the years to come, beyond the concerts at Rock à la Meuleuse (rock on the grinder) which we organized during our Rencontres in June 2016, we have plans to explore an illustration of our work through contemporary art.

Among the perspectives, we imagine a European network centred on technological sovereignty. In the world of development and international cooperation associations, this idea has been around since the 1970s, based on appropriate technologies: reclaiming ourselves, being more sociable, connecting and building links throughout Europe so that there are more exchanges between our different countries.

Our adventure is not without effort. Part of what helps us keep going is that we don't miss out on poetry, pleasure and being as we are. We thoroughly, and I mean thoroughly, explore the paths and horizons that are available to us.

One of the objectives for which we believe we are on the right track is the following: while in France local development has always been specialized, today things are actually de-compartmentalized. If we think about things more "globally", we will participate in developing something richer, more powerful and sustainable. What makes us strong is that we control the whole chain: self-building at the political and collective level.

We are full of energy: our desire is to testify that the fields we are exploring with the methodologies we use, can be applied to a whole bunch of other things.

The trend goes by several attractive names, like “smart” farming, “precision” or digital agriculture. The vision is common though: a 'technocentric' approach, including gradual to extreme mechanization of farm management supported by algorithmic, data-driven procedures and sophisticated tools, like cloud computing, specialized software, drones and Internet of Things.

Neither neoLuddism nor Corporate Ag - Towards a Holistic Agroecology

Vassilis Gkisakis

Will hi-tech save agriculture from its otherwise intractable problems? Certainly, technological stakeholders want it to appear so, as digitisation increases both in the fields and in the policy documents and future plans for the sector. Hi-tech solutions are promoted as unavoidable and necessary and are broadly publicised as the ultimate innovative path for the modernization of farming. In the quest for increased productivity, reduced costs and, notably, environmental sustainability, agtech is a core part of the answer - from the Commission to the companies invested in it.

The trend goes by several attractive names, like “smart” farming, “precision” or digital agriculture. The vision is common though: a 'technocentric' approach, including gradual to extreme mechanization of farm management supported by algorithmic, data-driven procedures and sophisticated tools, like cloud computing, specialized software, drones and Internet of Things.

The agri-industry and policy makers are majorly implicated in this new digital era: Giant agri-corporate mergers, like Bayer/Monsanto, develop a very strong parallel agricultural data-science agenda and market policy, buying smaller companies which specialize solely in data management related to soil, irrigation, weather or climate, like Monsanto did with start-up Climate Corp. Another mix of smaller, ambitious, and often opportunistic entrepreneurial players enter as well the agricultural sector with a multitude of promises on digital solutions to important agricultural and environmental issues.

Both EU and global data economy policies back these efforts by facilitating the creation of a market players’ ecosystem, including corporations, researchers, developers and infrastructure providers, in order to ensure that value will be extracted by data and a novel economic sector will rise. Of course, this new business expresses a genuine market-oriented and neoliberal approach, for delivering profits and entrepreneurship opportunities from new topics.

But, before evaluating the effectiveness of such solutions, we must identify the well-documented problems, stemming from the modern food production system. What is taken for granted both by scholars and international institutions like FAO, is that combating the scarcity of resources, the reduction of soil and water pollution, the greenhouse gas emissions and the loss of species and habitat are major issues that have to be managed

quickly. It is also undeniable that this kind of global change requires developing much more sustainable agricultural systems, which will depend less on high synthetic inputs and fossil fuels and will be characterised by efficient resource use, low environmental impacts and, last but not least, climate change resiliency, in order to produce sufficient and healthy food.

So, can digital and (bio)technological innovations really meet these goals? Despite the hype, it appears not to be the case. The paradigm derived by such approaches is largely conceived to aim only at a “weak” ecological modernisation of agriculture, as many scientific authors suggest. Their effect is restricted to a partial increase in the efficiency of inputs and resource use and some decrease of production costs, which are however accompanied by the high costs of farm management’s mechanization. Often these tools developed ignore main ecological processes, under whose principles the agricultural ecosystems function. In a better case scenario, these innovations may just lead to partial substitution of inputs with some short-term positive effects on the sustainability and stability of the food system. And that’s it. They fail to address serious concerns on the structural weakness of the modern food system, which generates a major part of the negative impact to environment and society.

Another key issue is the problematic innovation process followed. In the above-mentioned approaches, the narrative and practice of innovation is restricted to a framework of economically driven developments promoting technological solutions. The innovation transfer’s mode mainly follows a top–down procedure towards the end users, farmers or agronomists. Under this framework, as innovators are regarded only the scientists and agricultural advisors, who design and promote tools and practices, and companies, that develop and provide the technological solutions. Technological development is mostly out of reach to any but the agTech giants, as highlighted in the debate’s opening article. Suddenly sort-of-solutions become 'one size-fits-all' recommendations: farmers then must follow strategies and practices that evolve along with their research outputs and corporate technologies. In other words, these are innovation processes that create vertically developed and hierarchically-based tools, obviously fitting to serve better an industrially-scaled and profit-oriented farming system and the market itself.

Of course, the above criticism does not suggest some kind of agro-Luddism approach condemning advanced technologies, which are here already - like it or not. It has been already recognised that alternative examples of digital or analogue agricultural innovations that support the transition towards truly sustainable food systems can exist and are not inherently incompatible with the framework of an agroecological approach. The examples of open source agricultural technology initiatives, like farmhack in US, collaborative projects for the creation of technology solutions and innovation by farmers, as l'Atelier Paysan in France

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This article can be found at the ARC2020 website.

or international research projects, like Capsella. As many times described, agroecology is an emerging concept which provides a holistic approach for the design of genuinely sustainable food systems. It does not simply seek temporary solutions that will improve partially the environmental performance and productivity of the food systems. It stands mostly for a systemic paradigm of perception change, towards a full harmonization with ecological processes, low external inputs, use of biodiversity and cultivation of agricultural knowledge.

The important thing about agroecological design of the food systems is that they emphasize independent and participatory experimentation and not the reliance on high technology and external suppliers, with a high degree of dependency on additional support services. Therefore, it becomes obvious that hi-tech and any other technological solutions can stand as a complementary element to agroecological innovation processes, and only when the development of innovative tools includes a peer-to-peer planning framework and user involvement within the reach of an economy of the commons, as the above mentioned examples do.

Thus, the main issue is related to the way innovation processes evolve - in whose interests, and with who's participation, do they emerge? We should realise that innovation lies in the creative process, not only in the generated tool itself. Bearing this in mind, it becomes evident that it is the lack of autonomy that matters - in other words, the absence of the end user's engagement in the technology's development. Appropriately used, technology can share power with all actors collectively involved in developing the innovation. And this appropriate use of technology allows us to democratize knowledge.

Digital Consolidation – Entrenching Agrichemical Companies & Industrial Ag?

Jason Davidson, Friends of the Earth (U.S.A.)

This emerging industry is rapidly growing. Already, the same four mega-corporations that dominate the seed and pesticide industries (Bayer-Monsanto, DowDuPont, Syngenta-ChemChina and BASF) are moving to gain control of digital agriculture and outpace the growth of competitors.

Digital agriculture, broadly defined as the use of mass amounts of data to influence decision-making on farms, has incredible potential to make farms more economically and ecologically sustainable. However, it also poses risks to the privacy, profitability and independence of farmers.

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Currently, these “Big Four” platforms are Bayer-Monsanto’s Climate FieldView , DowDupont’s Granular, Encirca and AcreValue, Syngenta’s AgriEdge Excelsior and BASF’s Xarvio and Maglis.

The rise of digital agriculture can further foreclose paths for farmer innovation, serve as a powerful gatekeeper of farmer information and transform farmers from independent business operators to captured users. For example, digital agriculture services can provide exact prescriptions for seed planting and pesticide use. With corporate control over these algorithms, companies can tell farmers exactly where and how to treat their land. That same company has an incentive to direct farmers to use seeds and pesticides that they manufacture.

For example, BASF’s Grow Smart Rewards program offers cash back when farmers use its digital agriculture platform and buy certain pesticides manufactured by the company instead of competitors’ products.

Additionally, digital agriculture platforms are enabling major agribusiness corporations to gain access to tremendous amounts of farm data. Farmers own all of the individual data produced from their farm. The digital agriculture company owns all of the data aggregated from multiple farmers to recommend decisions. This is especially important when considering data portability.

In order to have complete control over their data, farmers must be able to transfer it to a different platform while deleting it from the old platform. While a farmer provides data through Climate FieldView to Bayer-Monsanto, they also receive recommendations based

on a collection of data from other farms. In other words, the farmers' collective data benefits all who have "invested" data into the platform.

However, Climate FieldView's privacy policy shows a farmer can only delete data that isn't currently being aggregated with other farmers' data.

Five neighboring farmers all growing the same crops could submit soil moisture measurements to a digital platform. The platform may view their measurements, compare them to yields, then offer all five farmers specific irrigation plans. All farmers would benefit from their contributions. Yet if one of those farmers became dissatisfied and decided to change platforms, the farmer cannot delete their soil moisture data from the database.

On the surface, this may not matter. But now, that farmer's neighbors are benefitting from his or her data. The neighbors might have a competitive advantage, while the farmer who left receives no compensation for their competitor's gain.

These data practices are anticompetitive: they allow a few dominant platforms to grow their databases and profit from farmers' data while offering nothing in return for the farmers that leave the platform. In order to be truly competitive, digital agriculture needs to allow farmers to freely remove data and transfer it to a new platform or delete it entirely.

Especially with a robust startup culture in the technology sector, there should theoretically be room for smaller companies to find their niche and offer their own digital agriculture platforms that give farmers more choices. These theoretical platforms would lack the conflict of interest inherent in the platforms of the Big Four companies who can use digital agriculture to push sales of their own products. However, In order to limit competitors from entering this market, the Big Four are utilizing a number of tactics, some of which are unique to the agriculture industry.

Bayer-Monsanto's design of Climate FieldView gives a perfect example of the ways in which tremendous resources can quickly lead to market dominance in a burgeoning industry. At this stage, Bayer-Monsanto's first priority is growth, measured in the number of acres on which Climate FieldView is paid for and deployed.

In 2017, Monsanto announced that it surpassed its goal of having Climate FieldView on 25 million acres and reached 35 million acres instead. Agriculture retailer incentives drive much of this growth.

Prior to the completion of the Bayer-Monsanto merger, a CoBank report predicted that the largest impact of the current wave of mergers (Bayer-Monsanto, DowDupont and Syngenta-ChemChina) would be on rebate programs. These programs have become extremely

important for retailers, who are required to sell a certain amount of a given product in order to receive cash back. The now-completed mega-mergers will primarily affect rebates in two ways.

First, larger companies have the power and capacity to push for higher sale volumes, which will increase the number of units retailers are required to sell to receive a rebate. Second, these new mega-corporations have more complicated portfolios than ever before.

Digital agriculture is one important piece of the new, complicated platforms and portfolios. In January, CropLife magazine reported that Monsanto was significantly increasing the rebate requirements for Climate FieldView. The author, Paul Schrimpf, speculated that it could be beneficial for some retailers to simply give Climate FieldView to farmers for free, just to reach the rebate requirements.

This control over retailer practices allows companies like Bayer-Monsanto to mass-distribute its digital agriculture platform — to the detriment of smaller, independent companies without a network of retailers profiting off of rebates.

Immense control over retailers has not been enough to stymie tech startups wanting to provide their own individual digital agriculture tools.

Many farmers use Climate FieldView for one or two very specific features. Therefore, there is certainly a market for startups to provide very specialized products that may be cheaper than a large platform and only offer what a farmer may find useful.

In 2016, Monsanto recognized this trend and decided to invest in the Microsoft playbook from the 1990s. Hence, the modern Climate FieldView platform was born.

Similar to how Microsoft turned Windows into a one-stop shop for computing needs, Monsanto expressed the desire to build a “centralized and open data platform.” In this platform, Climate FieldView acts as a sort of “App Store” for agriculture. Startups place their digital agriculture products within the Climate FieldView program for users to choose which ones they like. The startups gain increased access to customers while Bayer-Monsanto gets a share of the profit and access to all of the data.

Climate FieldView is the ultimate power play in a still-forming industry. Since the platform is rapidly growing, it has become a gatekeeper for other digital agriculture products. As a gatekeeper, Bayer-Monsanto gets to pick winners and losers, influencing the path the entire industry will follow.

Digital Consolidation – Entrenching Agrichemical Companies & Industrial Ag?

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The Big Four have almost complete control over conventional agriculture across the globe, and these corporations will increase dominance through digital agriculture. These aggressive practices and the potentially disastrous consequences are concerning for small family farmers. Digital farming only addresses the needs of industrial scale farmers and could be used to further lock farmers into a system of chemically intensive agriculture, where they are forced to use the seeds and chemicals the companies manufacture.

This agricultural technology could be a force for good, but it is already on pace to become as anticompetitive as the rest of the agriculture industry and simply another tool for corporate control over farmers — and our food system. It is important that we question how this technology will affect the future of farming and farm labor. Digital agriculture shifts farmer data ownership to mega-corporations so that these corporations can micromanage large sectors of farmland and limit farmer choice and competition — all for the benefit of their bottom lines.

To address this, policy must catch up to this emerging technology and offer farmers control over their data rather than leaving the issue to individual corporations to decide. In the meantime, farmers interested in utilizing data analysis can look to platforms provided by companies not manufacturing seeds and pesticides to ensure they receive unbiased advice.

The digital agriculture revolution does not have to follow the patterns of the past. Farmers' access to their own farm data must be protected to ensure it can be used to bolster the economic and environmental sustainability of agriculture. Digital agriculture must bolster farmer independence rather than increase corporate control over farmers and our food system.

For more information regarding digital agriculture, see Friends of the Earth (US) full report, Bayer-Monsanto Merger: Big Data, Big Agriculture, Big Problems. The report details the *myriad ways in which digital agriculture has the potential for gross corporate abuse of farmer data and how the combination of seeds, chemicals and data into combined platforms will increase corporate control.*

This article can be found at the ARC2020 website.

The development of tools and self-built machinery adapted to small-scale farming is a technological, economic and cultural instrument which has been little explored within agricultural development in France, although it can provide a significant impact on the growth of organic farming and contribute to improving organic farming practices.

Technical Sovereignty and L'Atelier Paysan's Tooled up French Farmers

Julien Reynier, Paris

L'Atelier Paysan is French non-profit cooperative. We started in 2009 in South of France as project with a group of organic farmers dealing with a new global appropriation of farm technology.

Based on the principle that farmers are themselves innovators, we have been collaboratively developing methods and practices to reclaim farming skills, achieve self-sufficiency and a technical sovereignty in relation to the tools and machinery used in organic farming.

Technical Sovereignty

Our goal is to make farmers imagine, and collectively create, adequate equipment and the means of production on the farm. This is in contrast to a trajectory of over-investment, over-indebtedness and over-sizing.

We believe we can make technical choices and invent sophisticated low-tech solutions. We don't want to be overwhelmed by trendy, plug-and-play and miraculous high-tech tools that will only make us more dependent, will be more intrusive and less controllable.

In 2011, we set ourselves up as a staffed organisation working to promote farm-based inventions. Our aim was to collectively develop new technological solutions adapted to small-scale farming, and to make these skills and ideas widely available through courses and educational materials.

We have also been offering resources and guidance to farmer-driven projects involving the building or renovation of agricultural buildings.

We have five trucks equipped with the machinery and materials we need to run about 80 practical training courses on farms and workshops across France per year.

More than 2.000 farmers have participated in our workshops in six years. We provide advice and guidance for small-scale farmers on agricultural tools tailored to their needs and accompany them through the trials and tribulations of their farming journey, individually or collectively, whatever their area of production – be it no till, direct seeding, processing tools, tractor, horse or hand power.

The development of tools and self-built machinery adapted to small-scale farming is a technological, economic and cultural instrument which has been little explored within agricultural development in France, although it can provide a significant impact on the growth of organic farming and contribute to improving organic farming practices.

Supporting farmer-led research and development In France, like every country where agriculture is kind of a mining industry, technological practices and tools are mainly driven by the agro-industry and correspond to its particular needs. Farms are somehow a substrate that nurture the profitability of a whole industry that capture most of the value.

Farms and farmers are involved in a strong path dependency to a socio-technical system. After decades of over mechanization and specialization, the new promise now is robotics and digital technologies. These will supposedly allow to us get rid of labour and vernacular farmers skills and decision making. This process is likely to continue, until farmers using these technological practices which are not tailored to their real needs, reassert ownership of the system-wide design of their farms.

We know that small-scale farmers are well placed to provide appropriate solutions to the challenges within agricultural development. What's more, in groups and networks, or with the support of a technical advisor, farmers can collectively develop solutions which are adapted to their own needs.

We believe that technological practices need to be made with/by/for farmers, and that technology needs to be collectively reclaimed to serve those who use it. We recognise the importance of social and technical farmer networks, both for production and knowledge-sharing.

On farm innovations

We identify and document inventions and adaptations of tools, created by farmers who have not waited for ready-made solutions from experts or the industry, but have invented or tweaked their own machinery. We seek to promote these farmer-driven innovations. Our internet forum, which acts like a collective sketch-book, is designed to make these contributions visible and accessible.

Farmer-led initiatives are gathered by our team and compiled into technical factsheets with photos, videos and testimonies documenting the tools and infrastructure developed by farmers. More than 800 technical factsheets have already been compiled and are freely available.

A Collective Approach - farmers working with engineers to design replicable machinery

We are also equipped to support and assist working groups who wish to develop tools adapted to their agricultural practices. Together, we compile a specification sheet for the tool we want to create. L'Atelier Paysan has a team of five to six mechanical engineers. This team can facilitate sessions with farmers and, employing their engineering skills and the use of computer aided programmes. We produce a draft design which is then corrected by the working group. After a feedback and responses, we begin prototyping.

Depending on the tool, prototyping can involve a training course where the group can learn or build on their metal working skills. The
prototype is then tested on farms and further design developments are made.

This expertise is essential in order to develop designs which can be replicated by anyone, using only metal bars and standard parts available in any hardware store as raw materials. Once the group has reached a consensus on the final design, Atelier Paysan can produce an open source design and begin to disseminate the tool through workshops and training courses. You can find on our website more than 50 tools with blueprints available.

Leading training sessions to create self-sufficient farming systems

We provide training courses for farmers to learn to make their own tools. In the course of 3 to 5 days, agricultural tools are created in the workshop. We rent workshop spaces across France where we organise training courses in response to the needs that have been voiced in that local area. Every participant in the course, whatever their level of expertise, is involved in the different stages of the tool’s creation, from drilling to cutting and welding. At the end of the course, those who wish to can pay for the costs of the raw materials and leave with a finished tool that they can go on to use on their holdings.

As well as building a tool, farmers gain in autonomy as they learn metal work. A farmer who has built rather than bought his/her tool is better placed to repair or adapt it in future. We have witnessed how the development of farmer-driven technologies and workshops allow farmers to gain skills and confidence, and engage in discussion on appropriate farm machinery.

This article
can be found at the
ARC2020 website.

Agro-industrial technologies, when adopted at the cost of medium- and long-term debt, create path dependence and lock farmers in to high-carbon practices.

Show me the Money - Debt, Technology and Path Dependence

Laura Skove, Paris

Technological advances in the 20th century, boosted by production-oriented agricultural policy, were responsible for the development of modern conventional agriculture. New technological advances in digital agriculture are poised to further transform the business and science of growing crops. But technology comes at a cost, and it is worth considering the impact of farm debt on farmers' ability to innovate and to transition towards agroecological practices. Agro-industrial technologies, when adopted at the cost of medium- and long-term debt, create path dependence and lock farmers in to high-carbon practices.

Credit

The conventional agricultural model was built on credit. The period of post-war reconstruction in France, where I teach and work in small-scale vegetable production, saw the introduction of the Common Agricultural Policy and guaranteed prices to ensure food security and self-sufficiency across the continent. These production-oriented policies have guided a shrinking number of farmers over the past decades to invest in larger land holdings and increasingly expensive machinery. The share of land held by large farms, defined as 100 hectares or more, continues to grow throughout Europe, as does the size of large farms.

In France today, the average farmer is saddled with almost 160 000 euros of debt, according to Agreste, the Ministry of Agriculture's statistical service. While family farms still account for the majority of farms in the European Union, an increasing number of small and medium sized farms pass out of family inheritance upon the retirement of the farmer. These are either purchased to expand existing farms—a move incentivized under the current CAP—or taken over by young producers setting themselves up in the business. The costs of installation are significant, and thirty percent of young farmers come from outside of agricultural communities. That may explain why, for farms managed by a producer under the age of forty, average debt is 200 000 euros, of which two-thirds is in the form of medium- and long-term loans.

This kind of debt leads to path dependency. Once a farmer has taken loans of that scale to purchase proprietary technology, difficult for anyone other than the original equipment manufacturer to even repair, his or her flexibility to innovate or change methods is severely

limited. The more complicated, expensive, and high tech the tool, the more intractable is the problem. Computerized tractors' engine control units are infamously difficult to access. The proprietary nature of the software, programming, and knowledge embedded in the tool poses a problem of ownership that is disenfranchising for the farmer and that locks him or her into a single way of doing business. Given the negative environmental externalities of the agro-industrial model, this is not only a concern for the farmer, but for all of us.

Paying for agroecological transition

On the other hand, agroecological transition comes with its own costs, and these are specific to the farmer rather than diffused across society. Soil depletion and high weed population density in the immediate absence of herbicide application mean that transitioning farmers deal with a significant decrease in yield for several years. The current subsidies in France for farmers converting to organic agriculture are largely insufficient to cover the serious yield gaps for fruit and vegetable farmers in the first three years of transition, during which time they are unable to sell their produce under an organic label.

For some cereal farmers, establishing predictable and productive harvests without phytosanitary products can take upwards of ten years; in the meantime, they scrape by with the RSA, France's work welfare scheme. While the CAP includes subsidies for maintaining organic agriculture beyond the initial transition, starting this year, national credits are no longer available in France to finance maintenance, leaving these subsidies to be solely funded by regional councils. While organic transition can make sense environmentally and philosophically, farmers who are not in a position to save enough money in advance to cover several years of negative cash flow find it to be an impossible proposition.

On top of yield gaps and insufficient long-term subsidies, farmers have to manage the new investments required in order to change to agroecological practices. Planting cereal crops directly into a cover crop allows a farmer to increase soil fertility while avoiding competition from weeds but may require investment in a specialized cultivator or pneumatic seeder. Winegrowers face even higher demands for investment in order to obtain organic certification: new vat houses and processing buildings mean organic winemakers have a ten percent higher debt ratio than their conventional counterparts.

Farm Hack and other options

All of this said, it would be a mistake to conclude that investment in agricultural technologies

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is necessarily inappropriate or unsustainable. This is not a question of using only technologies that pre-date the Second World War. While plowing with draft horses is part of France's cultural and natural patrimony, not all farms will or should use animal traction. Technology and agricultural policy are inextricably aligned; there can be no meaningful political intervention for agroecology without a sophisticated understanding of technological advances.

So how should a farmer in agroecological transition balance the need for appropriate technologies and the problem of debt? One option, featured already in this agtechtakeback series, is the kind of low-cost, self-built machinery promoted by L'Atelier Paysan and the Farm Hack movement, whose open-source model has been explored in other articles on this site.

Other advances are worth keeping an eye on. New Holland has pioneered a concept tractor powered by biogas. While the cost and the volume of biomass required will put this out of the reach of small-scale farmers, open-source plans for biodigesters are available through platforms like Solar Cities.

It is not out of the question to imagine a cooperative solution, where farmers in a community pool their waste materials to collectively reach the required biomass input. This may seem quixotic, and perhaps biomethane-powered tractors are not the key to the agroecological future; there are objections to land use for biofuels that merit a longer debate than there is room for here. The point, however, is to get creative about using technology in a way that is both innovative and feasible at a non-industrial scale. As the demands for green capitalism push corporations to think more creatively about sustainable solutions, the agroecological community should consider how to adapt proposed ideas to meet their needs.

The other vital piece of the transition is appropriate subsidies and support at the national and regional level. National governments have the flexibility to implement CAP reforms; France can decide to re-implement direct payments for maintaining organic farms, or to transfer more funds from Pillar 1 to Pillar 2 in order to ensure sufficient support for the agroecological transition. This can provide much-needed relief to indebted farmers and signal a way forward.

These solutions will not eliminate debt, of course. In many cases the single most significant investment a farmer faces is the purchase of land. For farmers who want to own rather than rent their farmland, this will continue to require loans, regardless of the farmer's choice of technology. But in a context where it can seem that any change requires spending money one doesn't have, these measures can ease the passage towards an agriculture that is truly sustainable, coherent, and ecologically sound.

This article can be found at the ARC2020 website.

Tech Revolutions, Retro-Innovations and Humus Farming

Stuart Meikle

Until the turn of the Millennium, farming and food was a backwater but since a more recent food price spike and the financial and property market crashes, it has become a golden goose that keeps on laying dividends and bonuses for the corporate world.

Do we have the time for more modern technical solutions?

With the passing of the Cold War era, one assumed centralisation was over. The free-market system was proven because communism had failed. It was a perverse conclusion. Three decades later are our economies truly free or is corporate control now so great that anything achieved by Moscow over the USSR is eclipsed by the power held within a few boardrooms around the World?

Is centralised control any more focused than it is within agriculture and food, be it in farm-input supply, food processing or retail? Until the turn of the Millennium, farming and food was a backwater but since a more recent food price spike and the financial and property market crashes, it has become a golden goose that keeps on laying dividends and bonuses for the corporate world.

This is the new agtech context. It used to be the domain of the pedigree farm-animal owner, the blacksmith or the farmer-inventor. Plant breeders were one unto themselves, quietly toiling in the faith that the next cross would deliver an income somewhere down the line. It was all a rather pleasant place to be.

Constraining farming's capacity to react to natural evolution

The 'Green Revolution' of the last sixty years has facilitated centralised control. As farmers have become increasingly dependent on purchased inputs [aka technologies] developed and sold to them by others, the number of input sellers has dwindled. As the agri-supply industry has consolidated, control has become concentrated in the hands of the few. This shows no sign of abating.

The needed R&D investment and an ever-tougher regulatory framework for pesticides and animal health products further combine to limit the number of players willing and able to supply farmers. In addition, there is rising consumer resistance on many green-revolution solutions. Hence, the prediction that the availability of these human-made, food-production tools will only decline.

One can go further. At what point will we reach peak fossil fuels and, hence, peak artificial nitrogen? Peak phosphates will also, in time, occur. Already regulations and taxes to control pollution, health and greenhouse gas emissions are coming in, with more likely in the near future.

As to the suite of pesticides, as with antibiotics and anthelmintics, natural resistance to them is becoming increasingly prevalent. Some pesticides are also being lost as unforeseen damage to the natural environment is being identified and attributed. There are those who argue that lighter regulation will help to ease the registration of new formulations but that is unlikely to occur.

Hence, can we rely on our human-made solutions for a sustainable food supply? To quote a pre-green revolution statement that almost foreshadowed the situation we are now in; “while the physical, mechanical and chemical genius of man has rapidly evolved… the processes of nature remain a law unto themselves” A quote from *Food, farming and the future* by Friend Sykes and written in 1950. Nature remains uncontrolled and we must recognise that it will not be controlled.

Climate change is making the headlines. Likewise, the need to dramatically reduce on-farm antibiotic use. The degradation of soils is finally getting a mention. But how often do we read about the threat to our food systems from the declining efficacy of pesticides and animal-health products?

We need innovation within our food systems like never before but have we become too focused on expensive, outside-the-farm-gate innovation? Farmers were always very innovative, but the last sixty years has focused upon solutions largely unsuited to simple, on-farm research. A consequence has been that control of food production has passed to those who govern the supply of technical inputs and away from the world’s farming communities.

Our food-producing solutions are now science-based but, going forwards, we must move from the artificial to the natural. Food production must again work with nature rather than against it - a retro-innovation. Such a change will allow more farmer-led innovation and a rebalancing of the ownership of food systems.

Is it time for farmers to initiate yet another agricultural revolution?

Over recent decades farmers have adopted new technologies with alacrity. It is reflected in yields. Wheat yields in the early 2010s in, say, France and the UK were 2½ and double

those of the early 1960s. A significant part of this rise was attributable to plant breeding [especially the introduction of short-strawed types]. Another factor was the more sophisticated use of more effective fungicides. Those two combined allowed the increased use of artificial nitrogen fertilizers [by the early 2010s the use of N in France was 2¾ times the 1960s level. In the UK it was 1¾ times (all from FAO data)].

Many farmers will say that while food production rose it facilitated the operation of a 'cheap food policy' and, thus, their incomes did not rise commensurately with farm yields. In other words, the farmers' adoption of technology has not been reflected in their profitability.

If recent technologies have not created a sustainable financial model for farmers, will they deliver a sustainable and secure food supply for society? The following examples indicate that they will not.

- On-farm antibiotic use is a massive concern as resistance to antibiotics used in human health care rises. Action will be taken quickly as the link between farm use and the consequences for human health is far clearer than if an impact chain has to be identified and understood.
- Resistance to ivermectin and other anthelmintics commonly used in cattle and sheep farming will have a productivity-loss impact for farms. Further its widespread, often prophylactic, use may be having additional and serious consequences as per "Short-term physiological and behavioural effects of ivermectin on dung beetles may have long-term consequences for beetle populations and ecosystem functioning". For 'ecosystem functioning', read 'soil health' as per its use for effective human food production.
- Glyphosate is a controversial subject. For some it is safe in the context of those who apply it, for others the concern is over the impacts that its widespread presence in the environment will have. Whereas its original farm use was highly targeted, it is now used routinely across whole landscapes. It is unlikely that the consequences are yet fully appreciated.
- The association being made between neonicotinoids and bee [pollinator] population decline has already led to a European Union ban on the use of such products in some situations.
- Black-grass resistance to herbicides like isoproturon and trifluralin used in cereal production.
- The use of chlorothalonil is now being questioned. It is a widely used fungicide for the control of Septoria in wheat production. It is also used in fungicide 'cocktails' to counter resistance build-up.

To the above can be added the issues surrounding nitrogen fertilisers, including their availability and cost, GHG emissions, air and water pollution during application, and the impact of nitrates on the health of many organisms (possibly counting soil microbes] including humans. Phosphate fertilizer availability is known to be limited while, in excess, phosphates are a pollutant whereby, in some countries, phosphate levels are legally constraining agriculture and, hence, food production.

Untangling the web of consequences from agro-chemical and fertiliser usage is complex but in the coming years it is a safe to conclude that regulatory and monetary constraints on usage will only rise. Hence, our farmers must adapt to having fewer, not more, tools in the human-made, food-producing tool kit. It is a major change and society must support them through the transition.

Finding innovation in the shadows of on-farm, farmer-led research

Farmers rightfully feel aggrieved that they are blamed for the impacts of modern food-production methods. The majority accepted the science and placed their trust in those who supply their farming inputs. It is the farmer who now gets blamed for the negative impacts, albeit they have delivered more food to the general populace at a lower financial cost. It is farmers who are accused of placing their profits before the environment while nobody seems to be attributing food production externalities to the widespread adoption of the negative-impact technologies created by others.

While farmers lose the public-relations battle, we now see the dichotomy of farmer-representatives defending the use of the very technologies that have led to that PR loss. In part it is a fear of the unknown. After decades of being taught and advised about how it should be done, it now requires a leap of faith to change. But change farmers must and it is imperative that farming's leadership and the farm-supporting government-agencies step up to the mark. If not, what is their role?

When assessing food production [aka agriculture] in the context of the complexity of issues facing it, one can conclude that the modern systems are breaking down. And accepting such a conclusion is imperative if we are to transition and change. If we don't, and we kick the can down the road, it will be the younger - not future - generations who face going over a food-production cliff-edge.

If we are indeed facing a 'conventional' farming breakdown, are there alternatives? Broadly speaking, these were highlighted within the context of my own soils-focused food and farming policy paper published by ARC2020.

More specifically, faced with the declining effectiveness of 'modern' food production technologies, the need to reduce net GHG emissions from farming, and restoring farmland biodiversity, we need to adopt:

- Regenerative farming systems that have little to virtually zero reliance on human-made inputs
- Free-range and herbage-based milk and meat production that supplies *eat-less-but-better* food
- Rotational farming that integrates livestock with tillage to create robust plant-growing systems
- Multi-species pastures with modified grazing methods that sequester carbon and rebuild soils
- Soil-health-first plant production that utilises cover crops, min/zero tillage, manures and composts
- Agro-forestry that integrates tree and hedgerow crops with grazing farm animals and biomass
- Farming that uses less fossil-fuels, generates its own power and captures emissions for energy

Inevitably the above will incorporate lessons learnt from organic farming but they will also include regenerative farming practices that have been developed by farmers who are not registered organic.

There will remain an important role for agri-tech going forwards, but its role will be to reduce usage and reliance on external-to-the-farm inputs and to provide back-stop interventions when all else fails. Into the long-term, it will only play a supporting role to regenerative farming.

After sixty years of focusing research upon 'conventional', input-hungry farming, the above alternatives are poorly supported by science-based research. Hence, if we now expect revolutionary food solutions to come already packaged and 'peer-reviewed', it is unlikely that we will be able to change farming and food systems fast enough; be it to address climate change, biodiversity loss, soil health collapse, or the efficacy decline of our modern food-production solutions.

Simply, if the research has not been funded and has only occurred outside the mainstream, we cannot expect to have solutions that adhere to mainstream research standards. It is not the fault of those who have been working on alternative systems that we, as a society, have chosen to put all of our food-system eggs in a basket that has now being found wanting. Given the time frame and the porosity of well-funded research, we must analyse what we have and to return the emphasis to the analysis of farmer-led research into practical, regenerative-farming methods.

And the upcoming CAP reform must do more than pay lip service to its supposed public goods targets: indeed, CAP reform is where supports can be put in place to turn promising regenerative practices into evidence-backed, on-the-ground sustainable farming. Some initiatives like the European Innovation Partnership point in the right direction, and there are some regenerative farming examples emerging under EIP, but these - especially farmer led EIPs - are in the minority. EIP wasn't always like this - the original idea, when ARC2020 was involved, as seen here 2013 and here 2014) was that it would be primarily farmer-led.

Back to the Future: retro-innovation from the ground down

For anyone who research the origins of many of the earlier listed alternatives, they will find that they are grounded in pre-1960 research, be it on-farm or formalised. It is work that would have provided the foundations of our food systems if we have not gone down the 'green revolution' route. Alongside analysing more recent work, we should revisit and learn from what has gone before - and again, this would allow for retro-innovation.

And if one doubts the merits of such an approach, see the two quotes below from the 1950s. Nearly seventy years old but for those who have already chosen to follow the regenerative farming route, it all sounds rather familiar...what was called soils-first farming, or back then humus farming.

"The deep-rooted ley is the pivot of humus farming… I have evolved a four-year deep-rooting ley. We know that 50 per cent of the plants included in this ley, such as chicory, lucerne, sweet clover, kidney vetch, cocksfoot, sainfoin and burnet, go deep into the subsoil for minerals that are evidently not available in the top few inches. Many of these plants can be traced down several feet into the ground. They will go down into the limestone rock and split the rock asunder in search of the minerals they need… these plants go down into the depths of the earth… in search of their requirements. Through the stems and leaves of the ley herbage, consumed by grazing animals and then dropped as dung and urine these minerals are brought into circulation in the top soil. By this method supplies of mineral and

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trace elements are continuously maintained and so long as a rotation of crops and ley are preserved, there cannot be any deficiency in mineral content".

Source: Food, Farming and the Future, Friend Sykes, 1950.

"I drew the gardener's attention to the wonderful quality and luxuriance of the crop generally....'now, the part of the garden which you are looking after yourself is an example of the mycorrhizal association -in other words the "living bridge" which Nature provides for the conducting of the sap and solutions of nutriment in the soil through a tubular or cellular thread to the plant. Some 80% of all our garden and farm plants are now known to be mycorrhizal-formers, and wherever you get organic manure properly composted, and the compost in an advanced humic condition, - in fact, wherever pure humus has been created by careful and skillful preparation -there you have these white threads of mycelium which are part of this almost mystical mycorrhizal association and function as a great feeder of the crop...'...any soil which is not forming mycorrhiza is definitely in bad condition. this can only be remedied by the application of humus, artificial fertilizers being definitely lethal to mycorrhizal formation"

Source: Humus and the Farmer by Friend Sykes 1956.

This article can be found at the ARC2020 website.

Promising more efficient farming, higher yields and environmental sustainability, AgTech has entered the mainstream, pushed by the EU, international corporations and national governments across the world.

Democratising AgTech? Agriculture and the Digital Commons | Part 1

Gabriel Ash

Agriculture 3.0 describes the increasing implementation and promotion of digital technologies in agricultural production. Promising more efficient farming, higher yields and environmental sustainability, AgTech has entered the mainstream, pushed by the EU, international corporations and national governments across the world. Increasingly, serious questions are raised about the impact of such market-oriented technologies on the agricultural sector. Who has access to these technologies? Who controls the data? In this 2-part piece, Gabriel Ash investigates the potential of Free/ Open Source Software to make agricultural digitisation more accessible.

Recently, a number of initiatives defending free access to agricultural knowledge have emerged. FarmHack, Atelier Paysan, The Open Seeds Initiative, and Open Source Seeds advance alternatives to the proprietary knowledge model of industrial farming based on ideas drawn from Free/Open Source Software. These initiatives respond to current trends in agricultural development and raise questions about its direction; they express an emergent concern for the commons against the drive to privatize knowledge. But why now? What is Free/Open Source Software (FOSS)? How is the FOSS model applied to agriculture? Finally, what are the opportunities and pitfalls such schemes present?[1]

Why now?

Artificial Intelligence, Big Data, blockchain, cryptocurrencies — these are today's 'hot' investment trends. The hi-tech ventures that seek to deploy these technologies receive the bulk of new investment in start-ups as well as media attention. The dominance of Information Technologies affects agriculture in two ways: First, an investment gold rush is building up in 'Agritech,' around buzzwords such as 'smart farming' or 'precision agriculture,' and a crop of companies that seek to make agriculture more efficient and profitable with information technologies such as drone and satellite imagery analysis, cloud based data collection, digital exchanges, etc. One gets a sense of the magnitude of the forces unleashed from browsing the offerings of start-up accelerators such as EIT. Second, businesses, regulators, politicians, NGOs, and the media adopt vocabulary, goals, expectations, and 'common sense' derived from Information Technology, which are then applied to agriculture.[2]

The dominance of Information Technology and its tendency to shape other industries as well as law and regulation is not simply the outcome of "market forces." Both the US and the EU have long promoted the dissemination of Information and Communication Technology (ICT) and the adoption of new intellectual property rights to support it. Thus, "the 2005 Spring European Council called knowledge and innovation the engines of sustainable growth...it is essential to build a fully inclusive information society, based on the widespread use of information and communication technologies (ICT) in public services, SMEs and households." According to António Guterres, United Nations Secretary-General, "we want to ensure that big data will bring the big impact that so many people need." It is taken for granted by policy makers that innovation and growth depend on commodified, proprietary knowledge, which in turn require reforming and unifying intellectual property rights.[3]

With the growing visibility of ICT, the policy drive for hi-tech innovation, and the push to commodify and privatise knowledge, alternative practices that first emerged within ICT—notably Free/Open Source Software—have also migrated into the mainstream, inspiring projects such the Creative Commons and Free Culture. They are also gaining a presence in agriculture.

What is Free/Open Source Software (FOSS)?

FOSS emerged in the 1980s among computer scientists and engineers who resented the way commercial constraints interfered with the norms of unfettered collaboration and exchange of information that prevail in science. In 1985, Richard Stallman created the Free Software Foundation (FSF), which launched the GNU project of free software tools. Breaking with the habits of commercial development, the software was written by volunteers in open collaboration over the internet and gave users full access to the source code as well as the right to freely share, tinker with and modify the program.

The FSF introduced a new relation between software producers and users, the General Public License (GPL), which effectively "hacks" copyright law to create the very opposite of a property right, a resource that obliges its users to place the fruits of their own labour in a shared common domain. By mandating that all derivative works must be distributed with the same license, this property of the GPL, called 'copyleft', prevents the appropriation and integration of free software in a proprietary product and guarantees that the code will remain free and open to users.

Although inspired initially by ideals of openness and freedom, FOSS did not evolve as a radical challenge to proprietary software. Companies large and small soon began investing important sums in open source development, creating new business models around it. In

1998, the shift toward as a more business-friendly model was formalized with the establishment of Open Source Initiative. Today the trend for new projects is towards licenses that eschew copyleft.

There is a perception that FOSS is US-centric. This is true insofar as the powerful US tech industry has shaped its major trends, but with important qualifications. Not only are there numerous European organizations promoting FOSS, but European countries, especially France and Germany, provide a surprisingly large number of participants. Furthermore, a number of Third World countries and public institutions have embraced it for political reasons.

FOSS is undoubtedly a success story. Its products, including heavyweights such as the operating system Linux and the ubiquitous PHP, MySQL, and Apache, power much of the web, and major ITC companies rely on it. It is also a realm of empowerment and meaning for the skilled programmers who contribute to it, one that implicitly invokes new forms of collective creativity, unfettered by the structures of intellectual property that support the expansion of the 'information society' and its attendant commodification of knowledge. Yet FOSS has not delivered on the utopian aspirations that are often invested in it. It has not subverted the dominant proprietary industrial structures, nor has it ushered a society of empowered technology users/creators. In David Barry's words, FOSS remains "precariously balanced between the need for a common public form in which innovation and creativity can blossom and the reliance, to a large extent, on private corporations…" that push forward the commodification and enclosure of knowledge.[4]

FOSS-inspired initiatives in Agriculture

Mechanized farm equipment manufacturers such as John Deer progressively moved toward digitized, software-controlled components that require authorized software access to repair, as well as restrictive contracts that forbid repairs and modifications. This inspired hackers, first in Eastern Europe, then in the US, to develop and share hacked versions of the control software, circumventing the manufacturers' protections. In the US, farmers who used those hacked versions joined a larger movement demanding legislation to protect 'the right to repair.'[5]

Addressing similar concerns from a different direction, FarmHack, established in 2010 and describing itself as "a worldwide community of farmers that build and modify our own tools," draws inspiration from the hacking culture of FOSS to promote low-cost, open farm technology. Participants share designs for farm tools and license them under 'copyleft' licenses. FarmHack seeks to "light the spark for a collaborative, self-governing community

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that builds its own capacity and content, rather than following a traditional cycle of raising money to fund top-down knowledge generation."

In France, Atelier Paysan was set up in 2011 with a similar basic concept, offering "an on-line platform for collaboratively developing methods and practices to reclaim farming skills and achieve self-sufficiency in relation to the tools and machinery used in organic farming." Unlike FarmHack, whose off-line presence is limited to meetups, *Atelier Paysan* is organized as a cooperative that owns a certain amount of equipment and provides workshops to farmers. *Atelier Paysan* publishes its collaborators' design under the same creative commons 'copyleft' license.

The enclosure and commodification of plant genome through patenting, licensing, and hybridization have spurred similar efforts. The Open Source Seed Initiative, a US organization created in 2012, describes itself as "inspired by the free and open source software movement that has provided alternatives to proprietary software," with the goal "to free the seed – to make sure that the genes in at least some seed can never be locked away from use by intellectual property rights." After initially trying and failing to devise a legally enforceable license, OSSI opted for a short pledge that is printed on all seed packages: "…you have the freedom to use these OSSI- Pledged seeds in any way you choose. In return, you pledge not to restrict others' use of these seeds or their derivatives by patents or other means, and to include this Pledge with any transfer of these seeds or their derivatives." As of today, OSSI's list of pledged seeds numbers over 400 varieties.

Last year, a second open seeds initiative was unveiled in Germany, Open Source Seeds, which has its institutional roots in ecological agricultural development in the Third World. Unlike FOSS copyright-based licenses, OSS license was devised under German civil contract law. The license, which is copyleft and includes derivatives, aims at combating market concentration. As one can expect for an organization that operates for less than a year, only five open source varieties are listed so far, all tomatoes.

This article can be found at the ARC2020 website.

[1] The account of FOSS below is highly indebted to David Berry's excellent analysis in Berry, D. (2008) *Copy, Rip, Burn: The Politics of Copyleft and Open Source,* Pluto Press, London.
[2] See the European Conference on Precision Agriculture Sponsors, the European Parliament report on Precision Agriculture and the Future of Farming in Europe, the European Commission's Communication on Future of Food and Farming .
[3] See European Commission (2005), p.4.
[4] Berry (2008), p. 144;
[5] See The Repair Association and Nebraska's Fair Repair Bill

This article can be found at the ARC2020 website.

If FOSS models become widespread, forms of accommodation between open and proprietary technologies are likely to emerge in agriculture as well, which could further advance the interests of agribusiness at the expense of farmers. It matters therefore how and to what ends FOSS schemes engage and mobilize users and producers.

Democratising AgTech? Agriculture and the Digital Commons | Part 2

Gabriel Ash

Can FOSS stem the tide towards the commodification of agricultural knowledge?

Acting against the grain of current economic and political structures and offering both valuable access and inspiring ideas about collaboration, the sharing of 'the commons,' and the future of work, these FOSS-modelled schemes are unlikely to be the last of their kind. But if they are to realize their full potential, it is essential that both the lessons of the history of FOSS, and differences in context between IT and agriculture, as well as the impact of the quarter century that separates the two moments in time, become subjects of reflection.

The reality of FOSS is significantly more complicated that the simple distinction between open and proprietary. In many products—the Android phone, for example—'open' and 'closed' elements co-exist, and tiered commercial projects with an Open Source base and proprietary additions are common. Furthermore, 'open' itself is a continuum, with various licensing schemes offering a range of different degrees of control. If FOSS models become widespread, forms of accommodation between open and proprietary technologies are likely to emerge in agriculture as well, which could further advance the interests of agribusiness at the expense of farmers. It matters therefore how and to what ends FOSS schemes engage and mobilize users and producers.

The history of the evolution of agricultural knowledge is also more complicated than a simple binary between proprietary and public. The Green Revolution replaced the informal, tacit knowledge of farmers with formal, scientific knowledge that was nevertheless organized as public knowledge, primary through institutions of research and higher learning. This phase of development elicited resistance and criticism for both the damage to farmers and ecosystems, primarily in the Third World, and for the denigration of centuries of accumulated local knowledge. This conflict was instrumental in the emergence of agroecology as a discipline[1] as well as in a range of efforts to foster better interactions between scientists and farmers.[2]

A second process that began shifting funding, control, and eventually the ownership of knowledge from the public to the private sector occurred later. In contrast to agriculture, software development never had the equivalent of farmers, and FOSS emerged purely out

of resistance to the second process. This difference implies that FOSS-inspired schemes in agriculture could be more complex and resilient, and potentially more effective alternatives. But it also opens more room for misaligned interests and internal conflicts.

The ideas of unfettered collaboration and democratic creativity that FOSS schemes invoke are not external to the development of the privatized knowledge economy and its attendant intensification of intellectual property rights. Workforce creativity, technological innovation, intellectual property rights, and economic growth are widely perceived today by policy makers as linked.[3] By advancing ideas of knowledge as common and knowledge production as free, FOSS-inspired schemes expose some of the internal contradictions of a model of economic growth premised on profiting from immaterial labour and the control and selling of knowledge. But they will not buck the trend towards privatized hi-tech agriculture alone.

Agriculture, however, may offer unique opportunities for linking FOSS-inspired schemes with other forms of engagement and mobilization on issues such as environmentalism and farmers' and peasants' rights, and the different ways each of the latter raises the question of the commons. Let these projects be the early shoots of a wide wave of reflection, experimentation, and mobilization around these questions.

[1] Gliessman S.R. (2015) *Agroecology: the ecology of sustainable food systems*, 3rd Ed., CRC Press, Taylor & Francis, New York, USA, p. 28.
[2] World Bank (2006) *Global - International Assessment of Agricultural Science and Technology for Development (IAASTD) Project*. Washington, DC: World Bank http://documents.worldbank.org/curated/en/753791468314375364/Global-International-Assessment-of-Agricultural-Science-and-Technology-for-Development-IAASTD-Project , pp. 65-68.
[3] See Barry (2008), pp. 42-43.

Imprint

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